

EFFECT OF LAND USE CHANGE ON FOOD PRODUCTION IN DEDE DIVISION, MIGORI COUNTY, KENYA

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Abstract: *Food production issues have dominated Kenyan Government development planning agenda for decades. Low food production have been experienced especially in areas where cash crops such as sugarcane are grown as it competes for rich agricultural land with food crops. Despite income from sugarcane, some households in Dede Division are still experiencing food shortages. This study assessed the effects of land use change on food production. The study adopted a descriptive research design with a sample size of 370 households drawn from a population of 9,503 households within the Division. Quantitative data was collected using household questionnaires administered to household heads. Qualitative data was obtained using key informant interviews (KII). More primary data was collected from direct observation and use of photography. Secondary data was obtained from published works, books and journals. Quantitative data was cross tabulated and the analysis presented in tables. Qualitative data was coded, compiled and integrated into the text. It therefore emerged that land use was correlated with food production ($r=-.560, p<.05$) and land relocation had a negative effect on food production ($r=-.657, p<.05$). The study therefore concluded that changes in land use by the households are responsible for the low food production in the study area and lastly relocation resulted in low food production in the Division. This study therefore recommends that there should be policies focused on encouragement of efforts of Non-Governmental Organisations already on the ground such as 'Njaa Marufuku' to improve food production, the Government should also put measures in place for the relocated population to be adequately empowered to improve their coping capacity.*

Keywords: *Land Use Change, Food Production, Non-Governmental Organisations*

1. INTRODUCTION

Every Sugarcane (*Saccharum officinarum*) is produced in more than 100 countries around the world and is widespread in the tropics and subtropics (Rehm & Espig, 1991). Sugarcane originated from tropical South and South East Asia. Crystallized sugar, extracted from the sucrose stored in the stems of sugarcane, was known 5000 years ago in India (Nassar, 2013). In the 7th century, the knowledge and production of sugar was transferred to China. Around the 8th century sugarcane was introduced by the Arabs to Mesopotamia, Egypt, North Africa and Spain, from where it was introduced to central and South America by Christopher Columbus (Roka *et al*, 2010). Brazil has the largest area under sugarcane cultivation in the world, being responsible for approximately one third of the global harvested area and production. For the year 2007, 6.7 million hectares were harvested with a production of 514 million tons of sugarcane. From 2000 to 2007 an impressive pace of approximately 300 thousand hectares of land was converted into sugarcane every year. She produces 739.3 million metric tons per year (Fischer *et al.*, 2008).

In Kenya, the total area under cane as at the end of the first quarter of 2004 was 107,622 hectares compared to 106,313 hectares in the same period in 2003, representing an increase of 1.2%. The increase was attributed to South Nyanza sugar belt as all the other zones experienced diminishing cane area (Evelyn, 2005). In South Nyanza sugar belt where the study area is, the desire to be economically independent has led to expansion of area under sugarcane farming as farmers donate land to their sons as inheritance hence leading to land fragmentation (Nyangweso, 2011). In 2003, a cane variety named Co 945 occupied the largest cane surface with 30,220 hectares, representing 25% of the total area. Variety N14 came second to occupy 28,262 hectares (23%). A sizeable bulk of the area amounting to 34,968 hectares (29%) had mixed varieties of unknown percentage (Evelyn, 2005). Locally, Sugarcane is primarily grown by small scale farmers which exert pressure on available agricultural land (Republic of Kenya, 2002). The total land area of Dede Division is 108.2 km² (10820 hectares). The total land area under small holder sugarcane farms is 59.3 km² (5930 hectares) out of which 4.1 km² (410 hectares) is large scale nuclear farm within Dede Division (Ndirangu, 2010). Traditionally sugarcane has been grown in Kenyan lake region for beer brewing and also for chewing. Commercialization of sugarcane in the region came with the establishment of sugar schemes by the government in the 1960's, eventually farmers in the area became interested in expanding cane production in order to maximize profits leading to a decline in attention and cultivation of subsistence crops (Aluoka, 1999). Some of these studies were conducted more than one decade ago. Economic and Socio-cultural changes necessitate another study. Secondly, none of these studies was carried out in Dede Division. Despite the realization of the expansion of area under sugarcane in the area, the studies failed to assess the effects of changes of land use on food production in these areas. This study therefore sought to involve the farmers' direct participation in the study.

Research highlighting the extent of expansion of land use for sugarcane production and how this affects food production in the study area is not well documented. Dede Division produces a total of 332,500 tons of sugarcane worth kshs 83.10 million to Sony sugar factory per year mainly from small holder farms. It is assumed that this is the amount spread among all the farmers supplying cane to the factory. The wide perception of sugarcane farmers is that they are food secure since they ought to be able to afford food at market prices from the farmers who grow or sell the food commodities (Ndirangu, 2010). This, however, is not the case as the average amount received is either too little or comes too late in between the farming seasons. The other misleading assumption is that farmers produce enough staple food to supply their household needs (Aluoka, 1999). Aluoka based his arguments on assumptions and perceptions; this study sought scientific evidence by seeking views from stakeholders in the study area. The truth is that the continuous enlargement of sugarcane farms at the expense of subsistence crops has created a situation where demand is there but supply is less hence prices of food have increased making it difficult for farmers to be able to afford the staple food in the open village markets (Aringo, 2008).

In Awendo area commercial sugarcane farming has been practiced for nearly thirty seven years with inception of Sony Sugar Limited Company in 1979. Expansion of land under sugarcane production increases the risk of low food production, particularly when such expansion is accompanied by a sizeable decrease in size of land under subsistence crops; this is so especially in areas where farmers have small parcels of land. Also, until the new cash crops start generating a profit, sugarcane growing creates uncertainties in food production and security (Netondo et al., 2010). These studies have shed light on contribution of sugarcane farming to low food production especially when farmers have limited land. Further, these studies touch on decrease in production of subsistence crops. Some of the studies also link competition for arable land between cash crops and food crops. However, there is limited evidence of studies carried out to assess the effects of changes of land use on food production. This study sought to fill this gap.

Some households relocated by sugar millers' nuclear farms have moved to nearby towns and others have moved far in search of new settlements (Wawire et al., 2011). Sugar factories require large tracts of land to set up nuclear farms which forms the first line of sugarcane supply to the milling factories. Milling factories which were recently established like Sukari industry in Homa Bay County (established in 2011) have no nuclear farms owing to the dense population in its immediate surrounding at the time of its establishment, however, factories established earlier on like Sony sugar company established in 1979 led to relocation of the locals in order to set up its nuclear farms.

Statement of the Problem

The desire to put more land under sugarcane may be the cause of the unbalanced land allocation in favour of sugarcane as both categories of farmers compete in expansion of sugarcane production and neglecting food crops leading to low food production. Being a recent phenomenon, this study sought to carry out an empirical study to determine the extent of expansion of land use for sugarcane production in the Division. Though the net income from sugarcane is marginally higher than the traditional cash crops, there is need to take into account the number of months sugarcane takes from the time it is planted to its full maturity which is between 18 to 22 months. Considering other financial demands like health and education, it is difficult to spread the cash received especially where those on salaried employment are few as in Dede Division. It is a common feature to notice that some households are faced with periods of inadequate food especially before sugarcane matures for harvesting. This study therefore sought to assess the effects of land use change on food production. At the beginning, Sony Sugar Company had to acquire large nuclear farms to support its initial crushing capacity. Relocation of people became necessary in order to create room for the nuclear farms. Out of those relocated, some bought land parcels and settled nearby within the Division. In most cases the resettled land is small and inadequate for both cash and food crop production since the compensation was inadequate. Despite studies done on sugarcane farming in other parts of Kenya, very little research has been carried out in Dede Division to establish the effects of relocation occasioned by sugarcane farming on food production. This study sought to fill this gap.

Objectives of the Study:

The overall objective of the study was to assess the effects of sugarcane farming on food production in Dede Division, Migori County. Specific objective was to assess the effects of land use change on food production in Dede Division, Migori County.

Research Questions:

What are the effects of changes of land use on food production in Dede Division, Migori County?

Significance of the Study

The findings may also be useful to sugarcane manufacturing factories as it offers reliable data available for them to make decisions regarding their Corporate Social Responsibility (CSR) in support of food production in their areas of jurisdiction. The findings of this research are important as they may assist in shaping the farmers attitude on importance of reducing acreages set aside for sugarcane and increase the ones for food crops.

2. METHODOLOGY

The study adopted descriptive research design. The target population of the study constituted all the households in Dede Division Migori County, local administration officials, Sony sugar agriculture officials and KESREF officers. According to the Kenya national bureau of statistics (2009), Dede Division had a total population of 45,152 having 9,503 households. This population is distributed amongst the two locations in the Division as follows North Sakwa location 22,874 (4,786 households) and West Sakwa location 22,278 (4, 7170 households). The sample size for households in the study was **370** drawn from a population of 9,503 households using Krejcie and Morgan (1970).

Both qualitative and quantitative data was collected. They consisted of both primary and secondary data sources. To successfully conduct the survey, the researcher used household questionnaires as primary instruments to collect the necessary data required for this study.

The researcher administered a semi-structured questionnaire as the main tool for collecting quantitative data from the household heads. Key informant interview guide was used to collect data from the key informants including the two chiefs from North and West Sakwa, five assistant chiefs from the seven sub locations namely Kadera Kwoyo, Kanyasrega, Kakmasia, Kanyamgony, and Kamresi, Sub-County agricultural officers from Awendo and Rongo, KESREF Research assistant and Sony sugar company Head of Agriculture which was used to obtain qualitative data which was also used to triangulate quantitative data in the research study. Observation checklist covered types of crops grown, types of dwellings and the dietary conditions. The researcher employed the use of photographs to record some of the data from the field especially those related to types of crops grown and sugarcane activities in the study area. This is data which have already been collected and analyzed by someone else. Such types of data was collected from KESREF offices at Opapo, Sub County Agriculture offices at Awendo and Sony Sugar Company – Agriculture Department; others were obtained from Books, Journals, the internet, published and unpublished works. To pilot test the research instruments, the researcher administered 10 interview schedules to a group of 10 non-sampled respondents within Dede Division in order to test whether the questions generated the responses appropriate and relevant to the study. This enabled the researcher to reformulate the instruments accordingly depending on the outcome of the pilot test. Qualitative data compiled from key informant interviews (KII) was categorized into broad themes, coded and classified into sub - themes, the themes and responses were then integrated into the text of the report which has supplemented the quantitative data.

3. RESULTS AND DISCUSSION

To achieve the effects of land use change on food production in Dede Division, Migori County, respondents were asked to state the size of their current land in acres, patterns of land use, acreage set aside for food crops and the yields that were realized in tons before and after commercialization of sugarcane and also the length of time that harvested food lasted in months. Data collected from the field was analyzed and presented.

In order to determine the changes in land use and relate it to food production, current sizes of land owned by the households in the study area had to be ascertained. Data on land sizes from the field was cross tabulated and analyzed results presented in Table 1.

Table 1: Current sizes of Land owned by Households in Dede Division

Land size	Frequency	Percentage
5 acres and below	311	84.1
6-10 acres	30	8.1

10 acres and above	18	4.9
Don't know	08	2.2
Non responsive respondents	03	0.7
Total	370	100

Source: Field data, 2014

In the study area majority of the households owned 5 acres and below, that is 311 households representing 84.1% of the sampled households. Between 6-10 acres was 8.1%, 10 acres and above was 4.9% and 2.2% did not know their farm sizes, 0.7% did not answer the question. The data confirms that land currently at the disposal of most of the households has considerably reduced. The reduction has meant that the amount of acreage dedicated to food crops has reduced. It is not only households but also the Kenya Government has had to grapple with major challenges in matters dealing with land. It was faced with the problem of ensuring that all land is put into productive use on a sustainable basis by facilitating the implementation of key land policy principles on land sector, productivity targets and guidelines as well as conservation of land quality in pursuit of food production (Musambayi, 2013). Kenya has not had a clearly defined National Land Policy since independence consequently the land question has manifested itself in many ways such as fragmentation (which results into small land parcels), breakdown in land administration and disparities in land ownership. These at times lead to social, economic, underutilization and abandonment of agricultural resources. In essence the effects of the role of women and men in land use and abandonment of traditional crops have led to low food production (Hlimi, 2013).

To gauge the changes in land use and its influence on food production, it was necessary to find out the patterns of land use and land ownership by the households in the study area. Respondents were asked to give the size in acres of the land they apportioned to different activities and the respective members of the households responsible for those activities. Data collected was analyzed and presented in Table 2.

Table 2: *Patterns of Land use and ownership in selected Households in Dede Division*

Activity	Ownership	Acreage	Percentage
Food crops	Female spouse	3.6 Acres	24.32
Cash crops	Male spouse	8.2 Acres	55.41
Livestock	Both Male & Female	2.0 Acres	13.51
Housing	Male spouse	1.0 Acres	6.76
Totals		14.8 Acres	100

Source: Field data, 2014

It was revealed that land is generally put into four main activities. Averagely, households have set aside 24.3% of their arable land to food crops and have gradually left women in control while 55.4% has been left for cash crops and it is the men who are in charge, 13.51% is set aside for livestock grazing and 6.76% of the acres are for setting up homes. With the coming of the cash crop economy, the role of women in providing food for the family in Dede Division has changed as shown in the table above. In this respect most women have now taken charge of food production especially the main cereals; in addition they are the ones in charge of cows and the calves as they do the milking. It was observed that women are involved in the milking and tending for the cows and calves while the men were more interested in the bulls as they are the ones used for ploughing and so they always ensure that they are well fed and ready for the purpose. Meanwhile as the women are apportioned small sections of the land to grow maize, the men, since they are the ones who traditionally own the land, and are the main decision makers deciding on what farming activity to be undertaken, apportion the largest chunks of the

land to sugarcane, such changes in roles of providing food to the family have a negative effect on crop production (Kilel, 1993).

Given that some of the land parcels within the study area are small (measuring 5 acres and below), giving priorities on what type of food crop to produce becomes a challenge to the households. The effects of land use change on food production could be established through analyzing the actual size of land left for staple foods like essential grains for example maize, millet and beans and also others like cassava and sweet potatoes and comparing the data with what was there some decades back before commercialization of sugarcane. The data obtained was analyzed and presented in Table 3

Table 3: Acreage set aside for selected food crops by households before and after commercialization of Sugarcane and their yields in Tons

Crop	Acreage		Yield		Acreage		Yield	
	Before	%		%	After	%		%
Maize	4.2	38.1	3.6	45	1.6	57.1	1.17	36
Beans	1.2	10.9	1.35	17	0.3	10.7	.45	14
Cassava	2.1	19.2	1.17	15	.3	10.7	.45	14
Millet/Sorghum	2.3	20.9	1.08	14	.4	14.3	.81	25
Sweet Potatoes	1.2	10.9	.72	9	.2	7.2	.36	11
Totals	11.0	100	7.92	100	2.8	100	3.24	100

Source: Field data, 2014

Maize had an average of 16 acres being dedicated to it before commercialization of sugarcane which produced an average of 3.6 tons of maize per harvest season which is 45% of the overall tonnage of produce for that season, millets or sorghum 2.3 acres giving 1.08 tons (14%), beans had 1.2 acres giving 1.35 tons (17%), cassava was at 2.1 acres producing 1.17 tons (15%) and sweet potatoes at 1.2 acres produced 0.72 tons (09%). More data collected from the field during this research shows that as opposed to the era before sugarcane was commercialized when the portion of land dedicated to maize by households was 4.2 acres yielding 3.6 tons of maize on average, the current sizes of land dedicated to production of this staple food crop has considerably reduced with maize currently having only an average of 1.6 acres per household dedicated to it which gives a paltry 1.17 tons which is 36% of the total harvest tonnage on average per harvesting season. Millet/ sorghum now has 0.4 acres giving .81 tons (25%), beans has 0.3 acres also producing .45 tons (14%) even cassava at 0.3 only produces .45 tons (14%) and lastly sweet potatoes at 0.2 produces .36 tons (11%).

The study further sought to determine whether a correlation existed between size of land owned and size of land under crop production. The findings are presented as shown in Table 4 that follows.

Table 4: Correlation between size of Land owned and size of Land under crop production

		Size of land owned	size of Land under Crop Production
Size of land owned	Pearson Correlation	1	.800**
	Sig. (2-tailed)		.000
	N	370	370
	Pearson Correlation	.800**	1

Size of Land under Crop Production	Sig. (2-tailed)	.000	
	N	370	370

** . Correlation is significant at the 0.01 level (2-tailed).

The findings in Table 4 on the correlation between Size of land owned and size of land under crop production clearly indicates that there is a strong positive correlation between the two variables ($r=.800$, $p=.000$). This implies that land under crop production was associated with size of land owned and therefore the size of land not used for sugar cane farming was very significant in crop production. Furthermore, the study sought to establish whether there is some association between land under sugar cane farming and size of land under crop farming. The findings are presented as shown in Table 5 that follows.

Table 5: Correlation between Land under Sugarcane farming and Land under food crop Farming

		Size of land under sugarcane farming	Size of Land under Crop farming
Size of land under sugarcane farming	Pearson Correlation	1	-.560**
	Sig. (2-tailed)		.000
	N	370	370
Size of Land under Crop farming	Pearson Correlation	-.560**	1
	Sig. (2-tailed)	.000	
	N	370	370

** . Correlation is significant at the 0.01 level (2-tailed).

The findings in Table 5 on the correlation between size of Land under Sugarcane farming and Land under food crop farming indicates that there is a moderate negative correlation ($r=-.560$ $p=.000$). This implies that land under food crop production was negatively associated with size of land under sugarcane farming and therefore the size of land used for sugar cane farming has led to a reduction in food crop farming.

Experts and policy makers have raised the alarm over planting one type of crop year in, year out. Bad practices in land use, they warn is threatening food production. Added to these, they say, is the shrinking sizes of agricultural land which is making farming expensive and that the cost of production in small farms is much higher, yet yields are low. Small scale farmers try to evade this cost by investing less in farm inputs such as fertilizer and quality seed, a move which is self defeating (Mbutia, 2014). Mbutia, however, carried out his study in Nyamira which is not a sugarcane dominated County and he was not explicit on the various competing land uses. Sometimes studies done in non sugarcane growing areas may not give a clear picture of the situation prevailing in a sugarcane growing area like Dede Division. Though they do give a glimpse of the challenges that accompany changes in land use such as diminishing sizes of land parcels used for food production. Obonyo et al., (2016), during a research on land fragmentation and food security conducted in Ugunja Sub-County tries to bring it out when he found that land use is commonly cited as an impediment to agricultural food production and development because of the inefficiencies involved in identifying the nutritional requirements for each successive food crop in rural farms. Preference for cash crops by households owning small land parcels as is the case in most parts of Nyanza makes it difficult to produce enough food. The small farms means applying

organic fertilizer and mechanization in agriculture through use of machines such as tractors is almost impossible hence productivity levels of food are threatened (Mbutia, 2014).

However, the land size dedicated to the food crops changed gradually with the commercialization of sugarcane farming which escalated reduction in land sizes dedicated to food crops as has been observed during a research done in Migori County by African Women’s Studies Centre (AWSC) in 2014 that one of the major challenges to food security in Migori County is small land parcels set aside for food crop production which is attributable to competition from sugarcane growing as men abandon their role of producing food for the family and concentrates on sugarcane production leaving women to carry out food crop farming. In majority of such households income from the cash crops(Sugarcane) hardly benefits the women and children.

The findings above compares well with those of Laure et al., (2007) who also found that size and type of land set aside for the crop influences its yields and that as the men set aside less fertile and small sections of their land for staple food production, it means low food yields from the farms. Though Laure et al., (2007) points at low crop yields as resulting from small land parcels set aside for crop production, the study does not suggest reasons behind the small land parcels, this is revealed in a study done by Kilel (1993) in Belgut, he noted that before cane introduction, the main cash crops in the area did not require large tracts of land and there was therefore little competition between cash crops and food crops. Since sugarcane requires large tracts of land for it to be commercially undertaken, this has caused stiff competition between the man and the woman of the household effectively meaning it is competition between cash crops and food crops. It is important to note that a crop such as beans has a slightly higher production since it can be intercropped with most of the food crops planted in the area. This study therefore corroborates the studies done by Kilel (1993) by affirming the biasness in land allocation.

To find out the adequacy of the food harvested from the farms to the households, the researcher sought to find out the length of time food harvested lasts before and after expansion of area under sugarcane farming. The respondents were asked how long the food lasted in months. The results were analyzed and presented in Table 6 below.

Table 6: Length of time harvested food lasts before and after expansion of area under Sugarcane

No of months	Before expansion	%	After expansion	%
Less than 1	00	0	62	16.8
1-2	11	3	214	57.8
3-4	45	12.2	80	21.6
5-6	300	81.1	10	2.7
More than 6	10	2.7	00	0
Non respondents	04	1.0	04	1.1
Total	370	100	370	100

Source: field data, 2014

It emerged during this research that the food crops harvested by the majority (81.1%) of the households lasted between 5 to 6 months before expansion of land under commercial sugarcane, 3% of the households harvested food lasting 1 to 2 months, 2.7% of the households harvested food lasting over 6 months and most importantly none (0%) harvested food lasting less than one month. However, after the introduction of commercial sugarcane, things changed and 16.8% of the households now harvested food that could not last even a month, 57.8% of the households harvested food that lasted between 1 to 2 months, 21.6% of the households harvested

food lasting 3-4 months, 2.7% of the households harvested food lasting 5-6 months and none of the households (0%) now harvested food that lasted over 6 months.

Since most crops especially Maize takes more than three months to be harvested, it means that most of the time the households have to look for the staple food elsewhere. Access to food as a problem is compounded by the continuous farming of commercial sugarcane at the expense of subsistence farming which has created more demand and less supply of food crop hence prices of food have increased making it difficult for farmers to be able to afford the staple food (Maize) in the open market (Aringo, 2008).

Plate 1 below shows a farmer's attempt to maximize the use of his half acre piece of land by planting kales side by side the sugarcane.



Plate 1 Mature sugarcane with vegetables (Sukuma wiki/Kales) grown side by side at Kadera Kwoyo sub location in Dede Division.

These findings are supported by a study conducted by Musambayi (2013) in three regions in Kenya on the impact of changes on land use and food production. Simple regression model was used to investigate the significance of the relationship between reduction in land size and food production. The results of the survey research showed that there is a significant relationship between land reduction and food production and that reduction in size has an impact on all the dependent variables. They depend on how the land factor is handled. In essence the smaller the land parcels the lower the food production.

The second objective mainly focused on the effect of land use change on food production. Having established extent of change in land use, the second step entailed establishing its effect on food production. Simple linear regression model was therefore carried out to establish whether a correlation existed between land use change and food production, its consequent effect and the proportion of change in food production accounted for by land use change. Scores of food production views from the respondents were regressed against scores of land

use change. The findings on simple linear regression model unique contribution of the land use change are presented as shown in Table 7 using standardized coefficients.

Table 7: Coefficients of Land use change

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.481	.063		7.639	.000
	Land use change	-.808	.026	-.868	-31.473	.000

a. Dependent Variable: food production

The findings as indicated in Table 7 shows that without engaging any variable in the model, there is a constant of 0.481 which is significant at 0.05, (B=.481, p=.000). This means that there would still be food production without the introduction of land use changes due to other variables. However, our variable of interest was land use change and the magnitude and strength of its effect on food production. The findings clearly indicates that land use change uniquely and negatively contributed towards food production ($\beta = -.868$, $t(370) = -31.47$, $p = .000$). There is a strong contribution of land use change if there are no other variables. It was also necessary to examine the proportion of variation in food production that was caused by land use change. The findings on this were therefore presented as shown in Table 8 that follows.

Table 8: Summary model results on land use change

Model	R	R Square	Adjusted R Square	Std. Error of Estimate	the R Square Change	F Change	df1	df2	Sig. Change	F
1	.868 ^a	.754	.753	.40499	.754	990.579	1	362	.000	

a. Predictors: (Constant), land use

The findings in Table 8 shows that land use change was correlated with food production (R=.868), a correlation that is considered strong. When this value is squared and multiplied by a 100%, we obtain the percentage change in food production accounted for by land use change, which was 75.4%. This is a large percentage and very significant, (F(1, 362)=990.579, p=.000) implying that the significance was not by chance but the choice of the variable was clear. Thus it can be deduced that land use change accounts for a significant proportion in food production such that the more the land is utilized on sugar cane farming the less the food is produced within the area.

The findings above are confirmed by data collected from key informants during this study which indicated that changes in land use in favour of sugarcane has led to low food production, this is further reinforced by findings from a study done by Netondo et al., (2010) where he noted that one of the principal causes of low food production is the social values tied to land ownership and that the key determinant underlying this is the traditional role of the man in matters of land. However, the common factor is that food production is reduced when the man directs his energies away from food production. Data collected from non crop farming communities also indicated that sudden changes in land use leads to reduced productivity. In a series of runs with the savanna model without the households' model, Thornton et al. (2003) found that about the same numbers of livestock could be supported on 196 km² parcels as on intact group ranches run by maasai morans. Model experiments with another area under a maasai women group showed that livestock numbers can decline

substantially due to the change. The effects of land use change are diverse and have the potential of reduction in the production levels in food especially with the commercialization of sugarcane farming which has complicated land availability to households for food production.

4. SUMMARY

On effects of land use change on food production, the study revealed that the role of women in food production has gained prominence. Food crops under the ownership of the female spouses are apportioned 3.6 acres of the household land while cash crops under the ownership of the male spouse are given 8.2 acres. Such changes in roles have led to low food production. In general, this study has revealed that acreage of land under food crop production has gone down. The main factor influencing these changes is sugarcane, Maize had an average of 4.2 acres being dedicated to it before commercialization of sugarcane and produced an average of 3.6 tons, currently, and maize has an average of 1.6 acres of land dedicated to its production which has reduced to 1.17 tons per acre. This study also revealed that the food crops harvested by the majority (81.1%) of the households lasted between 5 to 6 months before expansion of land under commercial sugarcane, 3% of the households harvested food lasting 1 to 2 months, 2.7% of the households harvested food lasting over 6 months and most importantly none (0%) harvested food lasting less than one month. However, after expansion of land under commercial sugarcane, things changed and 16.8% of the households now harvested food that could not last even a month, 57.8% of the households harvested food that lasted between 1 to 2 months, 21.6% of the households harvested food lasting 3-4 months, 2.7% of the households harvested food lasting 5-6 months and none of the households (0%) now harvested food that lasted over 6 months. Though some non-governmental organizations like 'Njaa Marufuku' initiative, in an effort to prop up food production have intervened. Their impact, lacking goodwill from both the national and county governments, are minimal. The study therefore concluded that changes in land use is responsible for the reduction in acreages under food crops which have in turn led to low food production within the study area.

Conclusion

The land available for food crop farming has become progressively smaller; this is a major effect of land use change. This comes out when changes inland use and ownership is put in perspective, the dominance of males in land allocation compromises food production in households as he apportions the best land to cash crops. This study therefore concluded thatthe competition between cash crops and food crops for land, with sugarcane (a cash crop) receiving higher priority in terms of acreage allocated to it, has led to low food production by the affected households. The nature of land use has changed to majorly growing 'sukuma wiki' in the resultant small farms for those near rivers (Plate 2). Those away from the rivers have turned to growing of sweet potatoes and dry-land rice which do not require large tracts of land through the interventions of some nongovernmental organizations such as 'Njaa Marufuku'.

Recommendations

Efforts of Non-Governmental Organisations already on the ground such as 'Njaa Marufuku' should be strengthened through tax concessions and government subsidies as they hold the key to improvement of food production. The strengthening of such initiatives should form a major focus since the benefits of dry land rice can be threefold; it is basically a food crop but can at times be a cash crop, it requires a smaller piece of land.

Suggestions for further research

Some Non Governmental organisations (NGO's) have been instrumental in alleviating food insecurity in different parts of Kenya. In the study area, Njaa marufuku is operational. This opens a field for research on the impact of NGO's in improvement of food production in sugarcane growing areas.

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